

basales 0.017×0.025 mm., *trigonis magnis acutis*. *Lobulus* diametro caulis duplo longior, decurrens, carina arcuata sinu lunato in folium excurrente, apice exciso-truncatus, angulo brevidentato, ceterum valde convexus, margine supero involuto. *Amphigastria* caulina ovata, caule plus duplo latiora, ad medium fere bifida, sinu angusto laciniis acutis. *Flores feminei* in caule ramisque pseudolaterales, raro in angulo furcarum. *Folia floralia* caulinis minora, arcuatim divergentia, e basi angusta falcato-oblonga, lobulo lanceolato profunde soluto, acuto. *Amphigastrium florale* foliis suis aequimagnum, oblongum, ad $\frac{1}{3}$ incisum, rima angusta, laciniis muticis.

Perianthia et *androecia* ignota.

HAB.: Florida (*Underwood*). *Lejeunea Caroliniana* monica est. *Lejeunea Austini* cellulis multo minoribus gaudet. A remarkable feature in this plant is the *large incrassations* at the angles of the cells, which form very distinct triangles with acuminate points.

Kaiser Wilhelm str. 9., Leipzig, Germany.

Flowers and insects. VIII.

CHARLES ROBERTSON.

ISOPYRUM BITERNATUM Torr. & Gray.—The plants grow in damp, rich woods, in small patches, notably about bases of trees. The stem rises a few inches and bears a few-flowered cyme, in which only one or two flowers are open at the same time.

The flowers are white, sometimes with a purplish tinge; they are strongly heliotropic and measure about 14 or 15 mm. across, the five oval petals expanding horizontally. The stamens are numerous, the outer elongating and discharging pollen first. Nectar is probably secreted by the bases of the filaments; insects probe among them with their proboscides, evidently for nectar. The four styles at first overtop the inner stamens, and have receptive stigmas before any of the anthers discharge, so that the flower is female in the first stage.

When the cyme contains two open flowers, one of them is commonly in the male, the other in the female stage. In case of insect visits, the latter is more apt to receive pollen from another stem, but may receive it from the older flower

on the same stem. If the stigmas are not pollinated before the outer anthers begin to dehisce, they might receive pollen from them by insect aid or by the closing of the petals. Later, when the inner anthers discharge, if the stigmas remain unfertilized, they may receive pollen falling from the anthers which now overtop them. But insects are by far the most important agents in effecting self-pollination, which, however, I think is the exception.

The flowers remain open all day and open on two or three successive days. For the attention of insects the plant is in strong competition with a number of plants, most of which have the advantage, especially *Claytonia Virginica*, which is much more abundant and more attractive.

The flower is adapted to short-tongued bees and flies, which come for both honey and pollen. It seems especially attractive to bees of the genus *Halictus*; the list shows all of the early-flying species I have found in my neighborhood, except *H. ligatus* and *confusus*, and more species than I have ever found on any other flower.

I have found the flowers in bloom from March 24 to May 12. On twelve days, between March 26 and April 25, I observed the following visitors:

Hymenoptera—*Apidae*: (1) *Apis mellifica* L. ♂, s. & c. p., freq.; (2) *Bombus americanorum* F. ♀, s., one; (3) *Synhalonia honesta* Cr. ♂, s., one; (4) *Ceratina tejonensis* Cr. ♂, s.; (5) *C. dupla* Say ♂, s.; (6) *Osmia albiventris* Cr. ♂ ♀, s.; (7) *Nomada bisignata* Say ♂ ♀, s.; *Andrenidae*: (8) *Andrena bicolor* F. ♂ ♀, s., freq.; (9) *A. sayi* Rob. ♂ ♀, s.; (10) *A. erigeniae* Rob. ♂ ♀, s.; (11) *A. flavo-clypeata* Sm. ♀, c. p.; (12) *A. rugosa* Rob. ♂ ♀, s.; (13) *A. forbesii* Rob. ♀, s.; (14) *A. claytoniae* Rob. ♂, s.; (15) *Agapostemon radiatus* Say ♀, s.; (16) *Augochlora labrosa* Say ♀, s.; (17) *A. pura* Say ♀, s.; (18) *Halictus gracilis* Rob. ♀, s.; (19) *H. 4-maculatus* Rob. ♀, s.; (20) *H. pectoralis* Sm. ♀, s.; (21) *H. coriaceus* Sm. ♀, s.; (22) *H. forbesii* Rob. ♀, s.; (23) *H. lerouxii* Lep. ♀, s. & c. p.; (24) *H. fasciatus* Nyl. ♀, s. & c. p., ab.; (25) *H. cressonii* Rob. ♀, s.; (26) *H. pilosus* Sm. ♀, s.; (27) *H. obscurus* Rob. ♀, s. & c. p., ab.; (28) *H. stultus* Cr. ♀, s., c. p., f. p.; (29) *H. zephyrus* Sm. ♀, s., ab.; (30) *H. imitatus* Sm. ♀, s., one; (31) *Colletes inaequalis* Say ♂, s.

Diptera—*Bombylidae*: (32) *Bombylius fratellus* Wd., s., ab.; *Empidae*: (33) *Empis* sp., s., one; *Syrphidae*: (34) *Chil-*

osia capillata Lw.; (35) *Melanostoma obscurum* Say; (36) *Syrphus ribesii* L.; (37) *S. americanus* Wd.; (38) *Mesograpta marginata* Say; (39) *M. geminata* Say; (40) *Sphaerophoria cylindrica* Say; (41) *Eristalis dimidiatus* Wd.; (42) *Helophilus similis* Mcq.; (43) *Xylota fraudulosa* Lw.—all s. & f. p.; *Tachinidae*: (44) *Gonia frontosa* Say, s.; *Muscidae*: (45) *Lucilia cornicina* F., s.

Coleoptera — *Coccinellidae*: (46) *Megilla maculata* DeG., f. p., one; *Chrysomelidae*: (47) *Diabrotica vittata* F., f. p., one; *Edemeridae*: (48) *Asclera ruficollis* Say, f. p.; *Anthicidae*: (49) *Corphyra terminalis* Say, f. p.

Hemiptera — *Capsidae*: (50) *Lygus pratensis* L., s., one.

SANGUINARIA CANADENSIS L. — This is a common plant of wide distribution. In my neighborhood, however, it is rather rare; at any rate, I know of but a few stations for it.

Each plant bears a single scape rising about one decimeter and supporting an 8 to 12-petaled, white flower, which expands about 4 or 5 cm. The plants are sometimes collected in little clusters, so that the flowers are made quite conspicuous and must attract insects from a distance. In the morning the petals are expanded horizontally, but in the afternoon they become more erect, preparatory to closing.

The flowers are female in the first stage. On the first day of opening, the large, two-lobed stigma is receptive, while the anthers are still closed. By the time the anthers are beginning to discharge, the stigma has turned brown, its papillae appearing shriveled.

The numerous stamens are of unequal length, the outer being much shorter. The tips of the inner anthers sometimes barely rise as high as the stigma, in which case, provided pollination has not previously occurred, the stigma might receive a little pollen from the surrounding anthers. The pollen is the attraction for insects, although I have seen hive-bees and *Bombylius fratellus* Wd. vainly probing for nectar about the base of the ovary.

The newly opened flowers are smaller and less widely expanded. Insects land upon them, dusting their stigmas before perceiving that the anthers are indehiscent. The result is cross-fertilization between distinct plants.

In competition with *Sanguinaria* are *Anemonella thalic-*

troides, *Isopyrum biternatum*, *Claytonia Virginica*, *Erigenia bulbosa* and *Erythronium albidum*, all of which have the advantage.

The flowers are monopolized by hive-bees, which collect the pollen so effectually that it is very difficult to find out what were the normal visitors of the flower. There is little doubt, however, that the plant originally depended for fertilization mainly upon the aid of bees of the genera *Halictus* and *Andrena* and flies of the family *Syrphidae*.

I have found the flowers in bloom from April 2 to 13. On April 13 I noted the following visitors:

Hymenoptera—*Apidae*: (1) *Apis mellifica* L. ♂, c. p., ab.; *Andrenidae*: (2) *Halictus zephyrus* Sm. ♀, c. p.; (3) *H. stultus* Cr. ♀, c. p.

Diptera—*Syrphidae*: (4) *Syrphus* sp., f. p.

Coleoptera—*Ædemeridae*: (5) *Asclera ruficollis* Say, f. p., freq.

I also saw several individuals of *Andrena bicolor* F. ♂ flying about the flowers in search of the female, which is probably a visitor.

At Madison, Wisconsin, May 9, Professor Trelease found the flower visited for pollen by *Andrena bicolor* F. ♀ and *Halictus confusus* Sm. ♀.

BAPTISIA LEUCOPHAEA Nutt.—This plant is rare in my neighborhood; I know of but one station for it, on creek bluffs. The stems rise about a foot from the ground, are diffusely branched and bear large, drooping racemes of handsome, cream-colored flowers.

The calyx tube measures about 5 or 6 mm. and serves to hold the petals so that they can not easily be separated by intruders. The banner runs forward for about 14 mm. when it rises nearly straight upwards. Its blade measures 20 mm. or more in breadth, and is not so strongly reflexed at the sides as in *B. leucantha*. The wings extend forward and conceal the keel. At the base above, the blade is inflected upon a gibbosity upon the base of the keel, with the result that, when a bee lands upon the flower, it depresses both wings and keel.

The stamens are distinct. Since there is no special opening at the base to admit the bee's tongue, as in the diadel-

phous Papilionaceae, the bee inserts its proboscis between the upper filaments. The filaments are somewhat unequal in length. The anthers dehisce in succession, so that to remove all of the pollen, bees must visit each flower several times. The stigma is situated among the anthers, and I find nothing to prevent self-pollination. The flower has more accessible nectar than in *B. leucantha*, but on account of its early blooming, it has less need of adaptation to exclude shorter tongues, since it is mostly exposed to *Bombus* females and species of *Synhalonia*.

Osmia latitarsis was the only bee visiting it for both honey and pollen, and there may be an important relation between the flower and the bee, which are both equally rare. I have as yet taken the female of this *Osmia* only on the present flower.

The following list of visitors was observed on May 16 and 19:

Apidae: (1) *Bombus separatus* Cr. ♀, s.; (2) *B. americanorum* F. ♀, s.; (3) *Synhalonia speciosa* Cr. ♀, s.; (4) *Osmia latitarsis* Cr. ♀, s. & c. p.

TRIFOLIUM PRATENSE L.—(“Adv. from Eu.”)—I have been much interested in observing how frequently this well-known bumble-bee flower is visited by Lepidoptera. It is a common thing for bee-flowers to be visited to some extent by butter-flies, but this seems to me to be an unusual case. In Germany, Müller found it visited by 8 Lepidoptera in a list of 39 insects, while in Illinois I have found it visited by 13 species in a list of 20. Our flowers are exposed to a richer butterfly-fauna, so that we may expect to find a larger proportion of butterflies upon them, and the differences between bee and butterfly-flowers may not be so well indicated in the lists of visitors.

But while butterflies may sometimes effect cross-fertilization of the red clover, they are of doubtful value, if not injurious. Bumble-bees depress the keel so that their heads and proboscides are well dusted with pollen. But butterflies can insert their thin tongues without depressing the keel, and even if they get a little pollen on their thin proboscides, it is apt to be wiped off by the closely approximated tips of the petals, which close the mouth of the flower.

I have found it in bloom from April 26 to Nov. 4. On 15 days, May 10 to Sept. 11, I noted as visitors:

Hymenoptera—*Apidae*: (1) *Bombus ridingsii* Cr. ♂, once; (2) *B. separatus* Cr. ♂ ♀ ♀, ab.; (3) *B. pennsylvanicus* DeG. ♀ ♀, ab.; (4) *B. americanorum* F. ♂ ♀ ♀, very ab.; (5) *B. vagans* Sm. ♀, s., one; (6) *Anthophora abrupta* Say ♂ ♀.

Lepidoptera—*Rhopalocera*: (7) *Danais archippus* F.; (8) *Argynnis cybele* F.; (9) *Pyrameis atalanta* L.; (10) *P. huntera* F.; (11) *P. cardui* L.; (12) *Lycaena comyntas* Godt.; (13) *Papilio cresphontes* Cram.; (14) *Pieris rapae* L.; (15) *Callidryas eubule* L.; (16) *Pamphila peckius* Kby.; (17) *P. cernes* B.-L.; (18) *Eudamus tityrus* F.; *Sphingidae*: (19) *Hemaris axillaris* G.-R.

Birds—*Trochilidae*: (20) *Trochilus colubris* L., thrice.

The following table gives the visitors which have been observed sucking the flowers in the normal way:

REGION.	<i>Bombus</i> .	<i>Anthophora</i> .	<i>Eucera</i> .	<i>Anthidium</i> .	<i>Megachile</i> .	<i>Osmia</i> .	<i>Bombylius</i> .	Lepidoptera	<i>Trochilus</i> .	Total.
1. In Low Germany—Müller, ¹ ...	12	1	1	1	1	1	8	..	..	25
2. In the Pyrenees—MacLeod, ² ...	6	1	..	..	..	..	1	11	..	19
3. In Illinois.....	5	1	..	..	..	..	..	13	1	20

HEUCHERA HISPIDA Ph.—Each plant of this common species bears several scapes, which rise 6 to 9 dm., and bear long panicles of greenish flowers.

The calyx is oblique, being quite gibbous on the lower side. It measures about 6 mm. in length, the lobes being directed forward and a little inward and the petals filling the intervals, so that the effect is much the same as if the parts were united to their tips. The tube is very broad, measuring about 4 mm. wide, so that it readily admits the head and thorax of a bee.

The stamens lengthen and discharge pollen in succession, beginning with the upper one. Accordingly, to collect all of the pollen, the flower must be visited several times.

The flowers are proterogynous³ with long-lived stigmas, and are remarkable for being visited exclusively by a species

¹ Fertilization of Flowers. ² Pyreneënbloemen. ³ Müller, Fertilization of Flowers, 243.

of *Colletes*, *C. heucherae* Rob., the females coming for honey and pollen, and the males for honey and in search of the females.

It blooms from May 11 to June 29.

LYTHRUM ALATUM Ph.—The plants are common in wet places. The stems grow 4 or 5 dm. high, are much branched and bear many loose racemes of purple flowers. The six petals are each marked with a reddish line leading to the base. They expand so that the flowers measure 15 mm. across.

The dimorphism of the flowers was first recorded by Halsted in the Bulletin of the Iowa Agricultural College, 1888. In the short-styled form the stigma reaches the throat of the calyx tube, and the stamens are exerted from 3 to 4 mm. In the long-styled form the stigma is exerted about 3 mm., and the anthers only reach the throat. In this form the stamens are variable, sometimes giving an appearance of trimorphism; but the unequal length seems only to prevent crowding of the anthers in the narrow tube.

The plants often grow in large patches, which renders them quite conspicuous, and very attractive to insects. The calyx-tube is narrow and measures 5 or 6 mm. in length, which restricts the visitors to long tongues. The principal visitors are butterflies. On 12 days, June 18—Aug. 18, the following list was observed:

Hymenoptera—*Apidae*: (1) *Bombus virginicus* Oliv. ♀, s. & c. p., freq.; (2) *Melissodes bimaculata* Lep. ♂, s., freq.; (3) *Megachile petulans* Cr. ♂, s.; (4) *M. brevis* Say, ♂ ♀, s., freq.; (5) *Coelioxys 8-dentata* Say ♀, s.; (6) *Epeolus lunatus* Say ♀, s.; *Andrenidae*: (7) *Agapostemon nigricornis* F. ♀, s.

Lepidoptera—*Rhopalocera*: (8) *Pieris protodice* B.-L.; (9) *P. rapae* L.; (10) *Colias philodice* Godt.; (11) *Pyrameis cardui* L.; (12) *Chrysophanus thoe* B.-L.; (13) *Pamphila peckius* Kby.; (14) *P. cernes* B.-L.; (15) *Pholisora catullus* F.—all s.

Diptera—*Bombylidae*: (16) *Systoechus vulgaris* Lw.; (17) *Exoprosopa fasciata* Mcq.; (18) *E. fascipennis* Say—all s.; *Syrphidae*: (19) *Helophilus latifrons* Lw.; (20) *Tropidia quadrata* Say—both f. p.

Carlinville, Ill.